

# Missouri River Mainstem Reservoir System

## 2011 Flood Regulation

US Army  
Corps of Engineers

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Omaha District  
Chief, Water Control and Water Quality  
Section

**August 29, 2012**



US Army Corps of Engineers  
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# Missouri River Mainstem Reservoir System

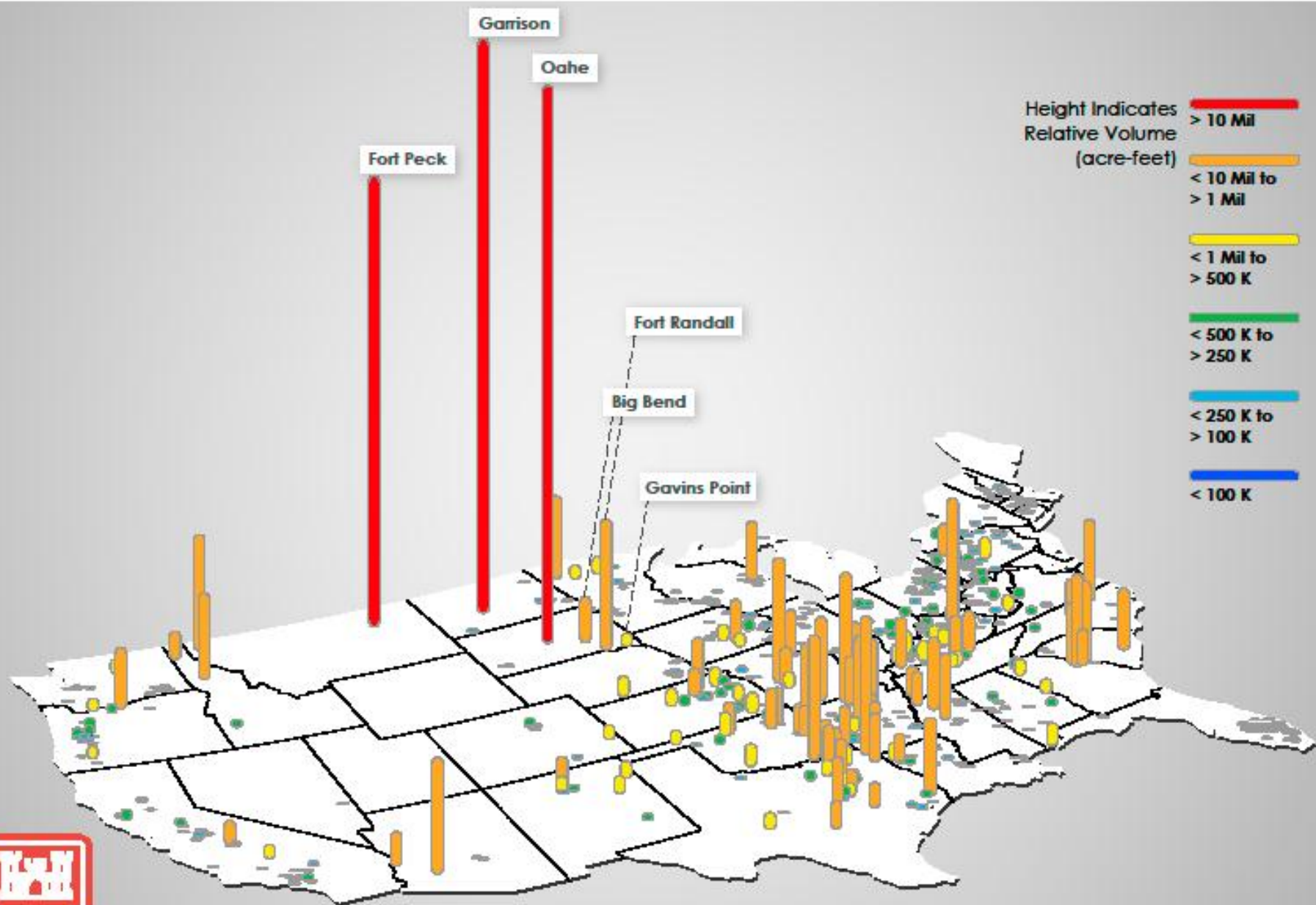


## Congressionally Authorized Project Purposes

Flood Control  
Navigation  
Hydropower  
Irrigation  
Recreation  
Water Supply  
Water Quality  
Fish and Wildlife  
(Including endangered species)

**Bank Stabilization and Navigation Project  
Sioux City, IA – St. Louis, MO**

# Storage Capacity of Corps Reservoirs



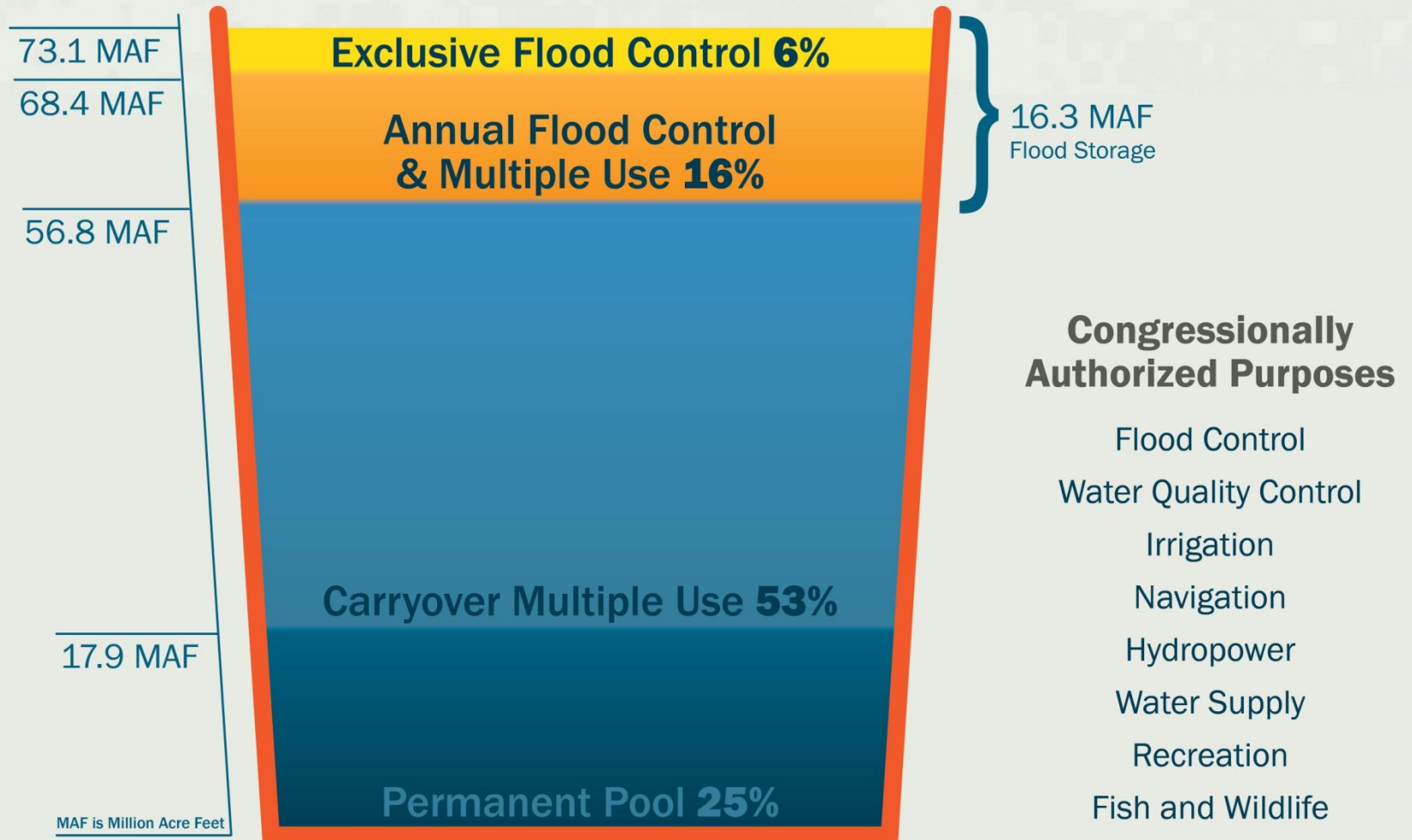




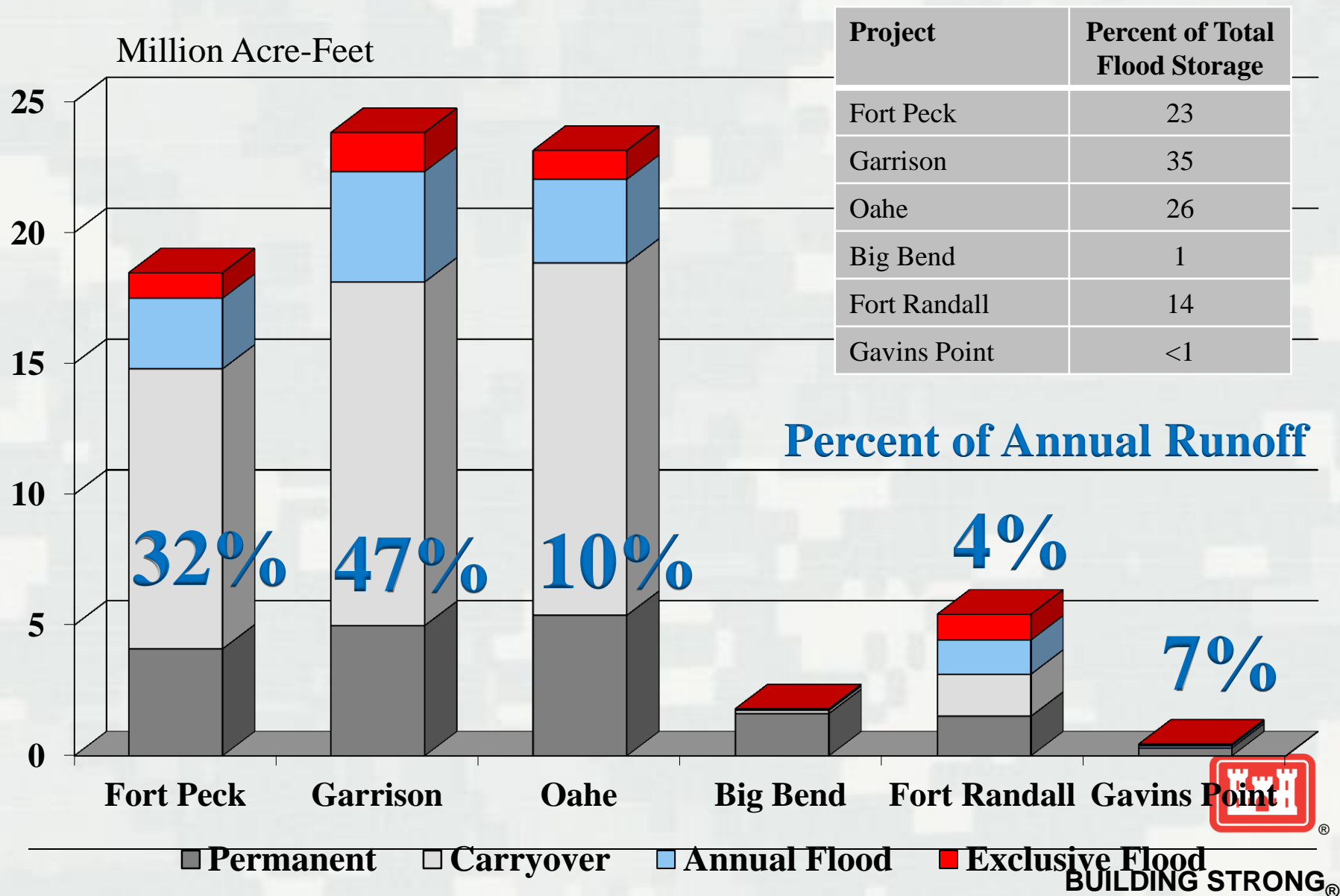
US Army Corps of Engineers  
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# Missouri River Mainstem Reservoir System

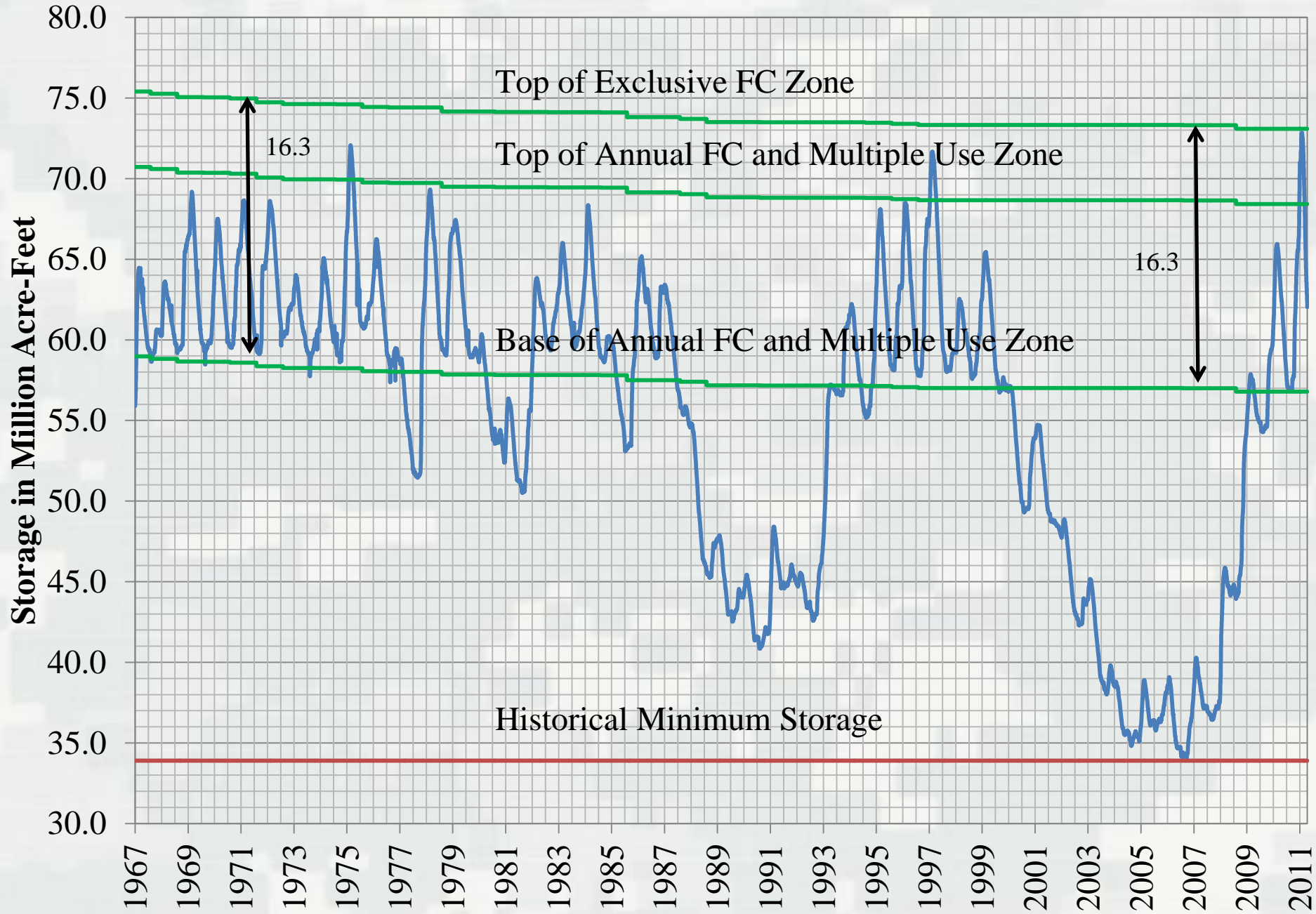
## Zones & Allocations of the Total Storage Capacity



# Mainstem Reservoir Storage Capacity



# Missouri River Mainstem Reservoir System





# 1881 Flood - Omaha



# Flood Control

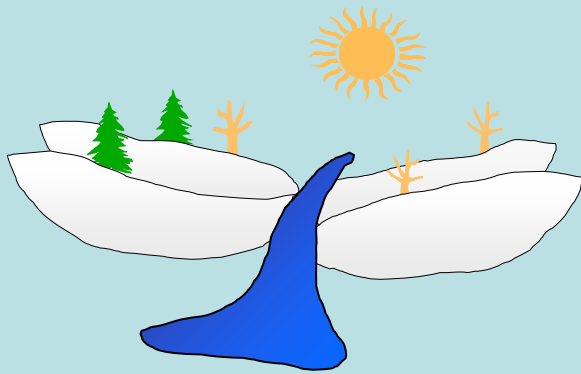
- 1881 Flood used as the design flood for the flood control storage.
- **March to July** runoff estimated at ~41 million ac-ft at Sioux City, Iowa in 1881.
- ~ 16.3 million ac-ft of storage for flood control
- Assumed a peak release of 100,000 cfs (Fort Randall)
- 48.7 million ac-ft in 2011 / 37 million ac-ft in 1997.
- 47 % of drainage area is downstream of mainstem reservoirs.





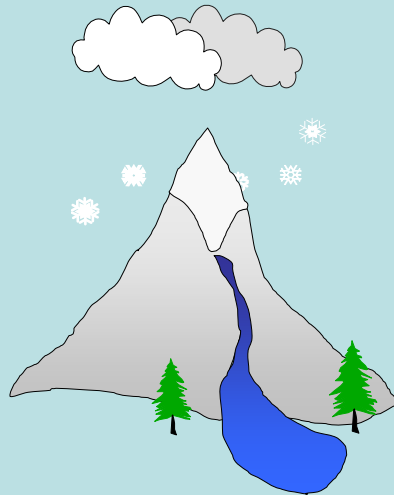
# Runoff Components

Plains Snowpack



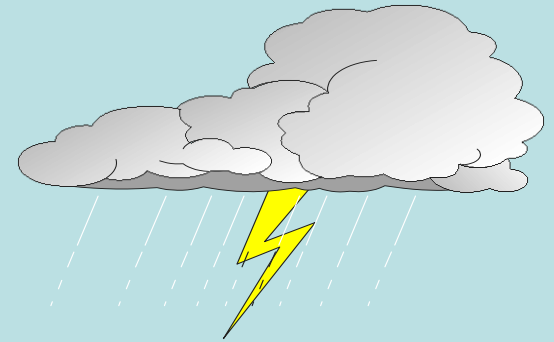
March and April

Mountain Snowpack



May, June and July

Rainfall



March through October

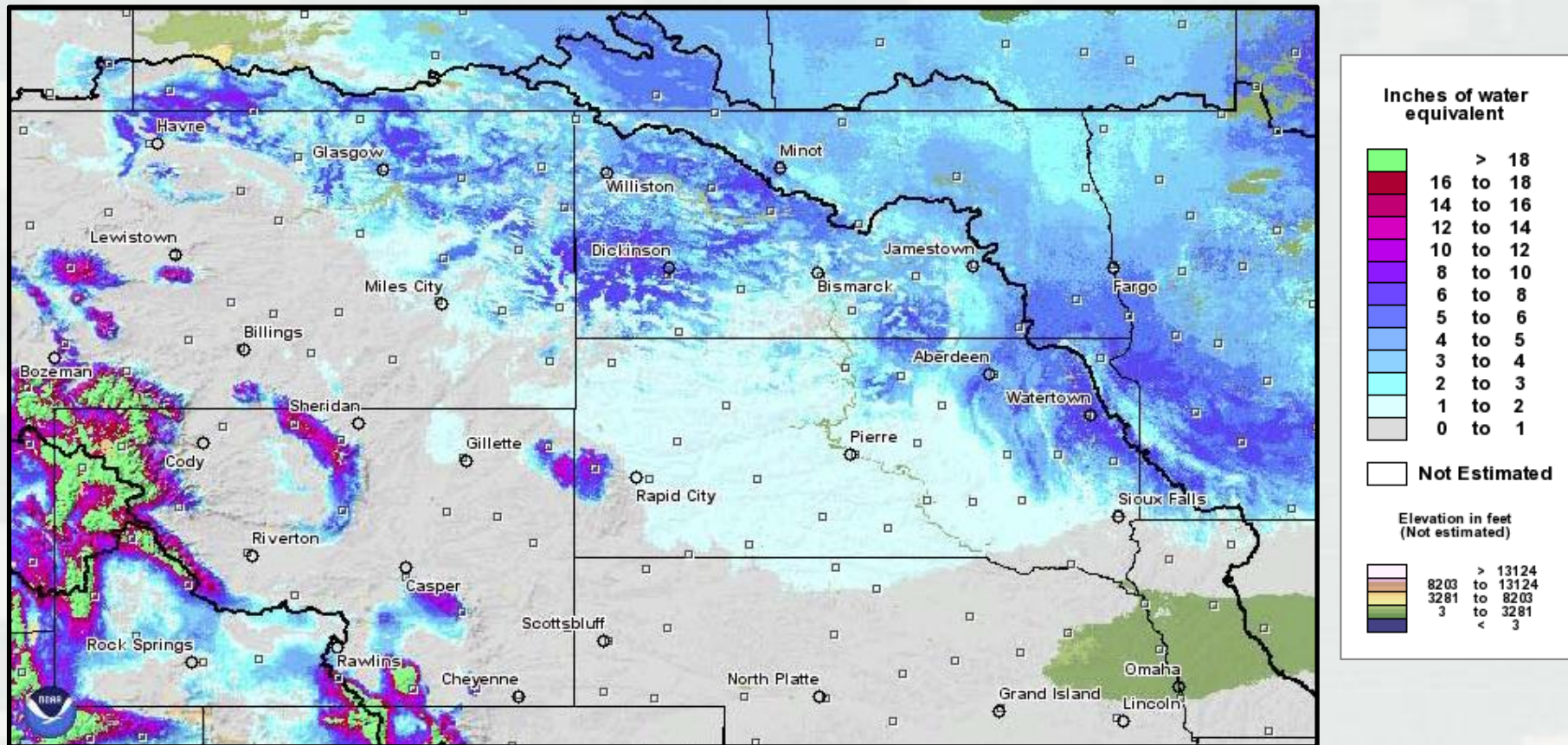
2011 Runoff = **61.0** MAF

Highest runoff since 1898

Previous Record was 49.0 MAF in 1997

# Plains Snowpack

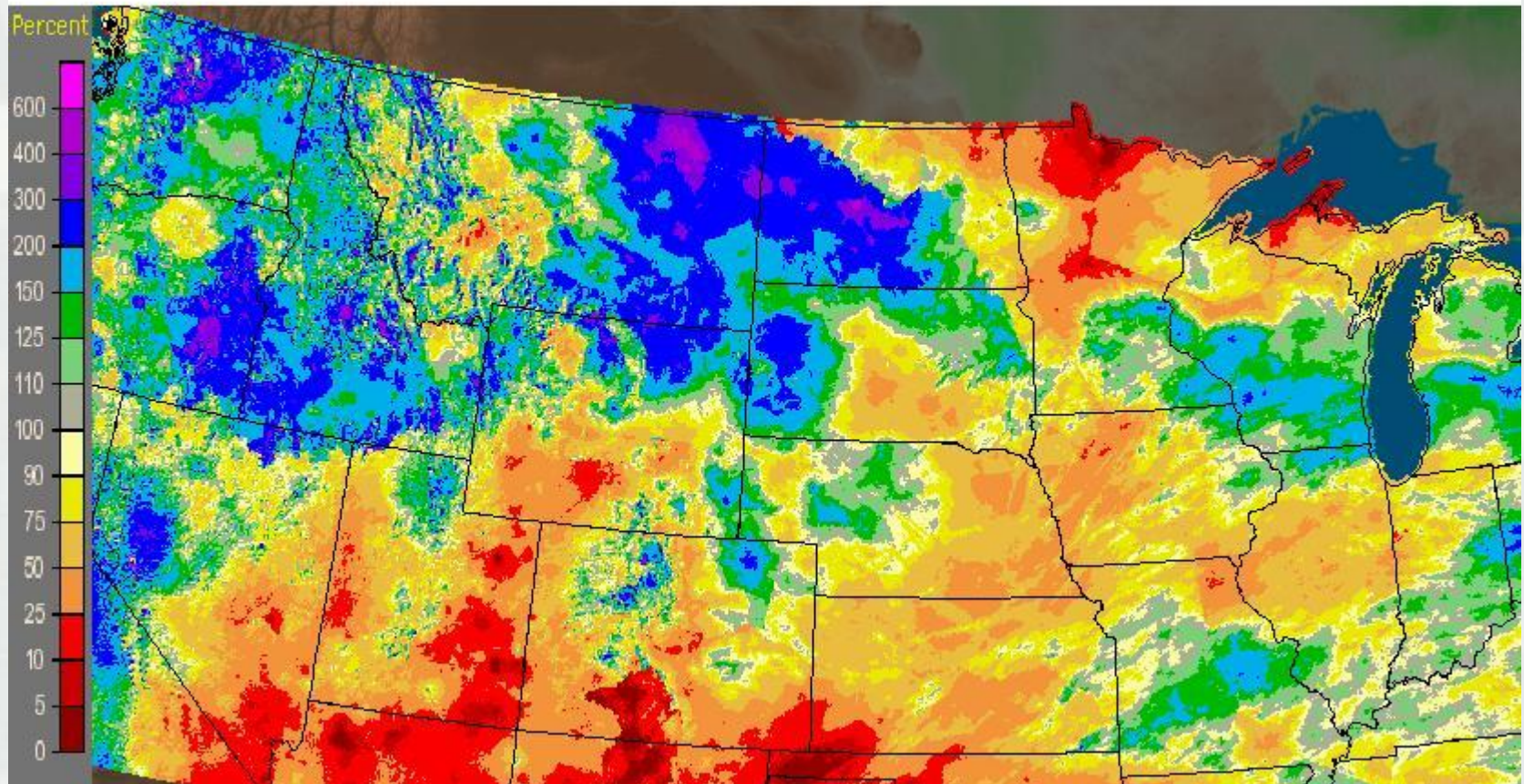
25 February 2011





# March 2011 Precipitation (% normal)

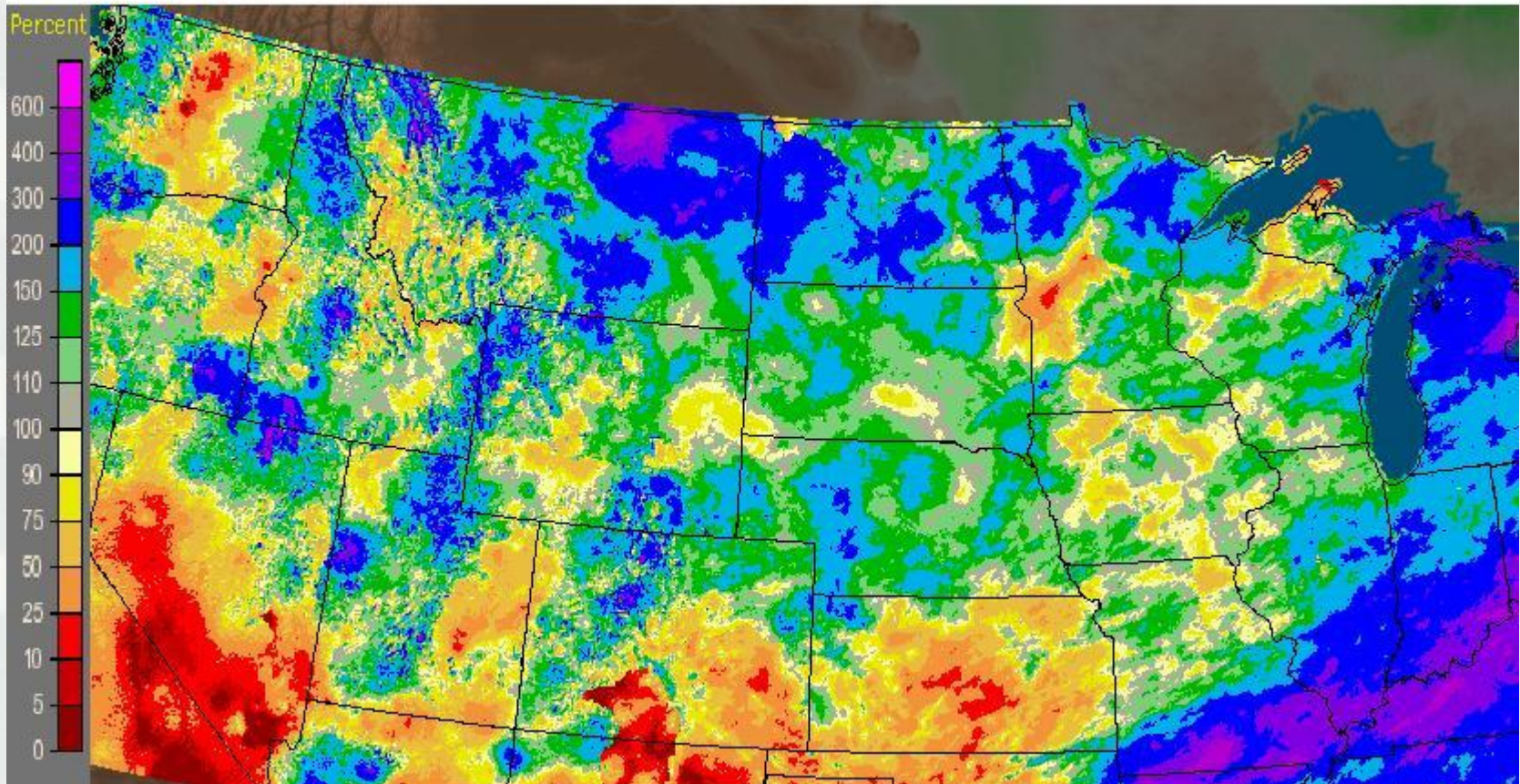
Missouri Basin RFC Pleasant Hill, MO: March, 2011 Monthly Percent of Normal Precipitation  
Valid at 4/1/2011 1200 UTC- Created 7/2/11 1:08 UTC





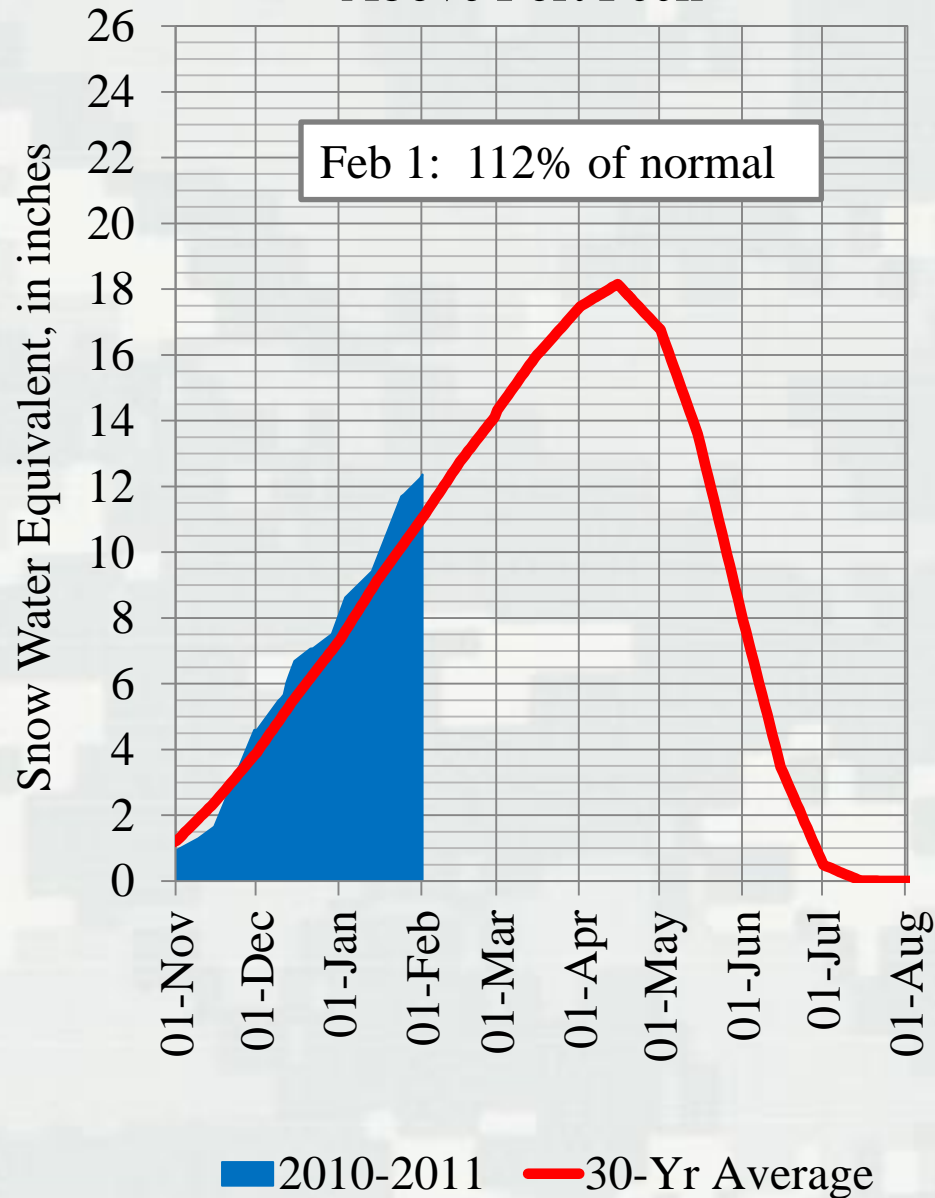
# April 2011 Precipitation (% normal)

Missouri Basin RFC Pleasant Hill, MO: April, 2011 Monthly Percent of Normal Precipitation  
Valid at 5/1/2011 1200 UTC- Created 7/6/11 15:27 UTC

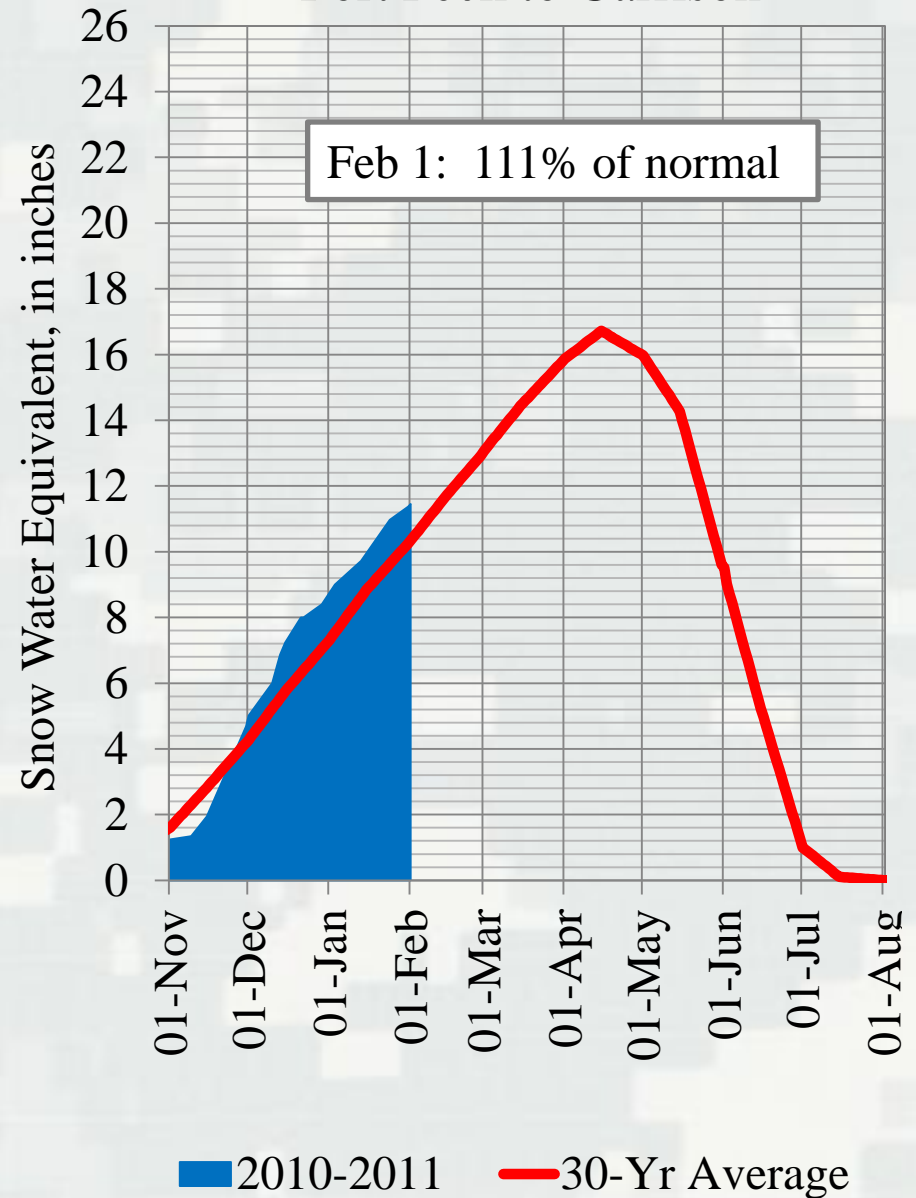


# 2010 – 2011 Mountain Snowpack

## Above Fort Peck

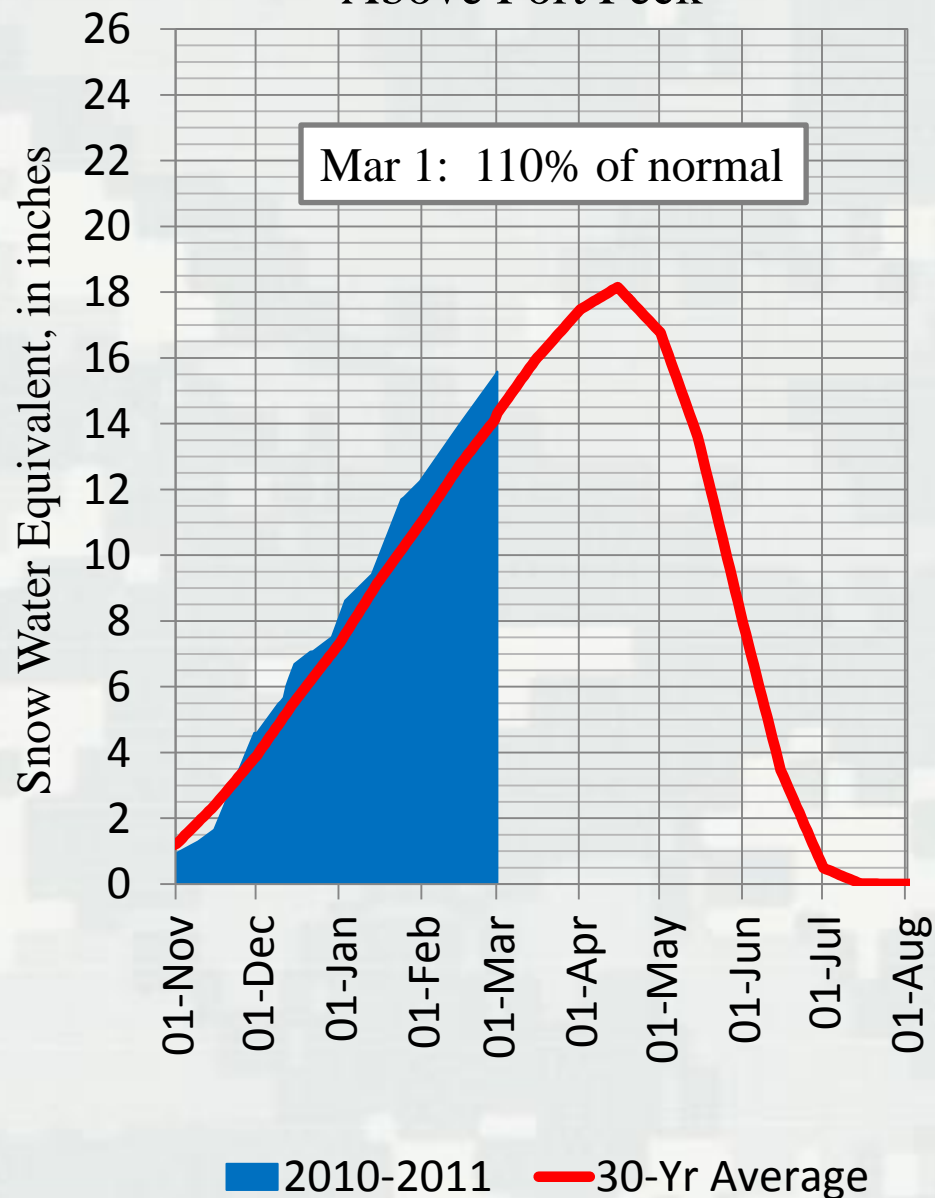


## Fort Peck to Garrison

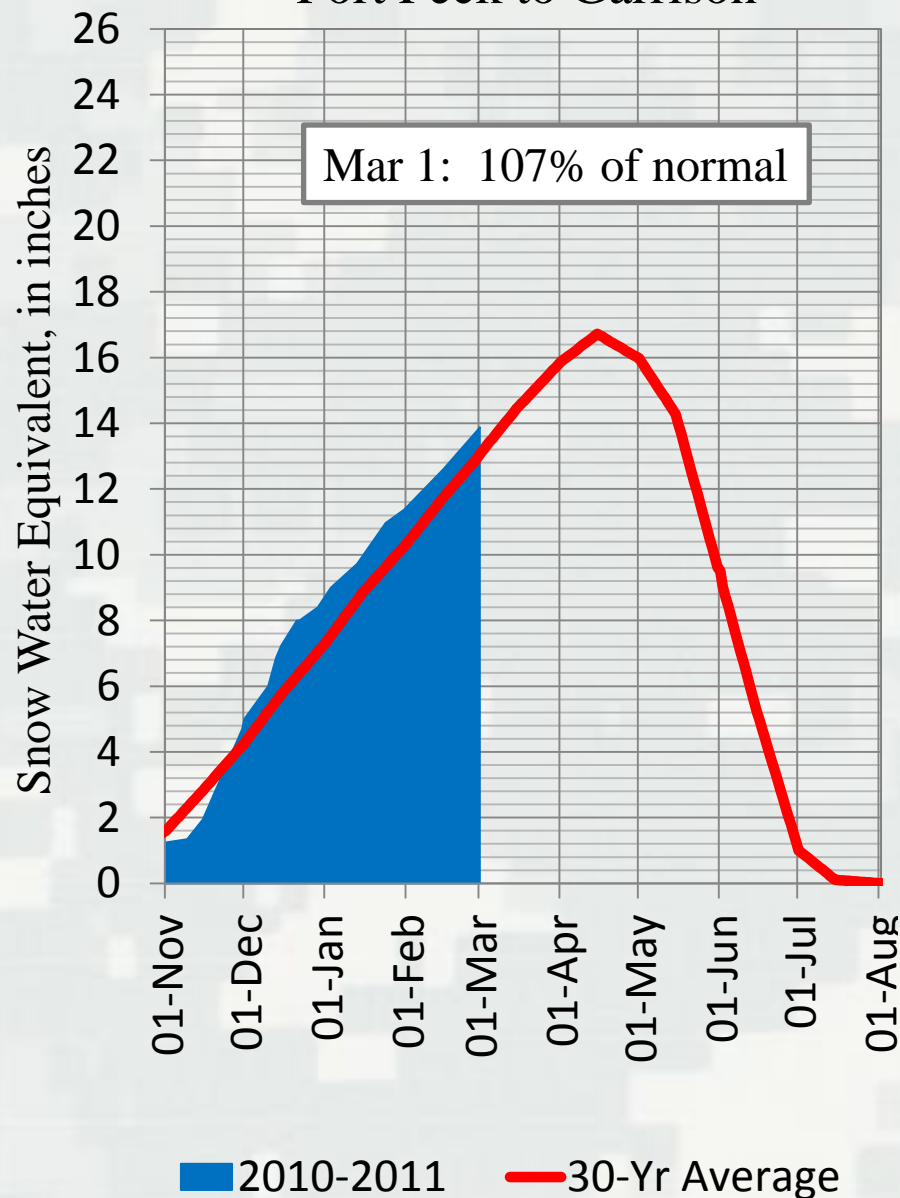


# 2010 – 2011 Mountain Snowpack

## Above Fort Peck



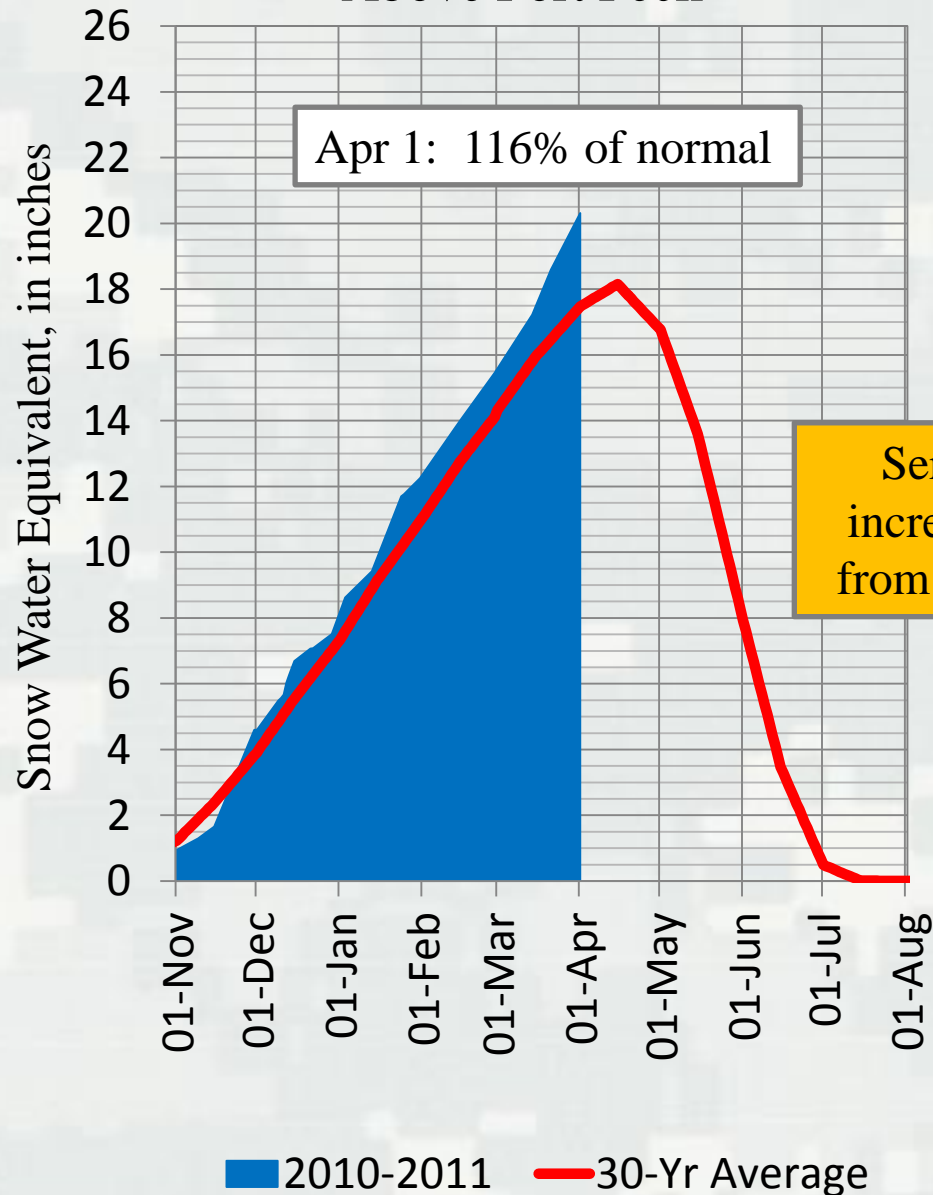
## Fort Peck to Garrison



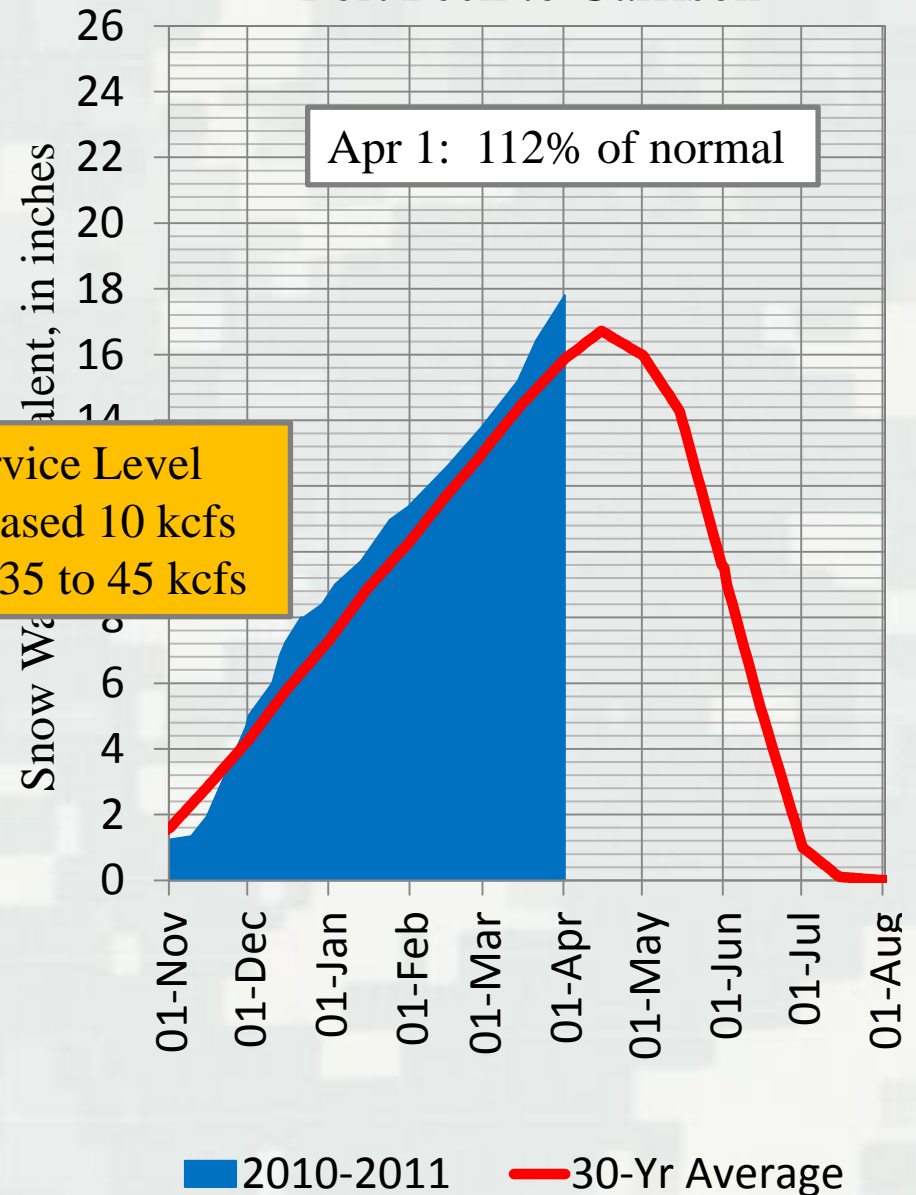


# 2010 – 2011 Mountain Snowpack

## Above Fort Peck

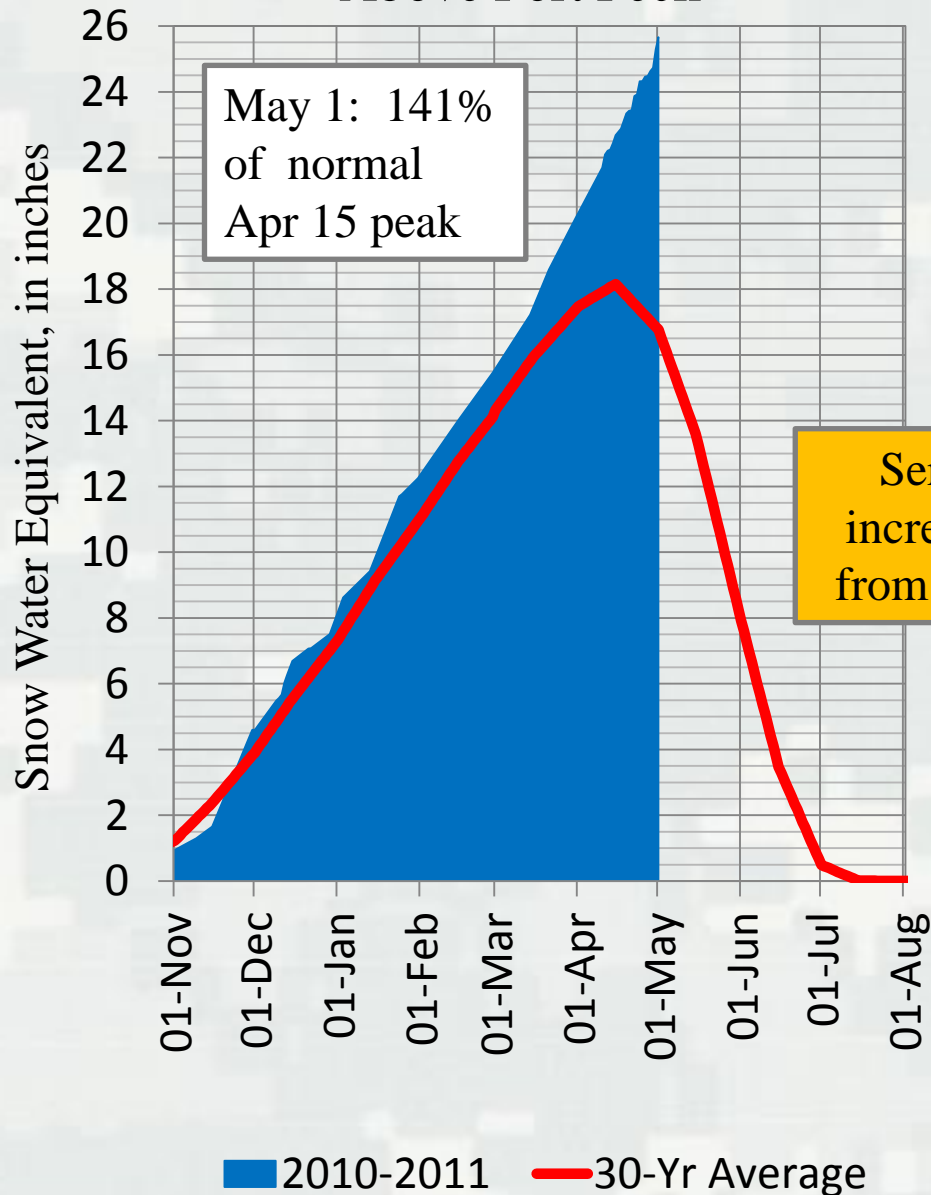


## Fort Peck to Garrison

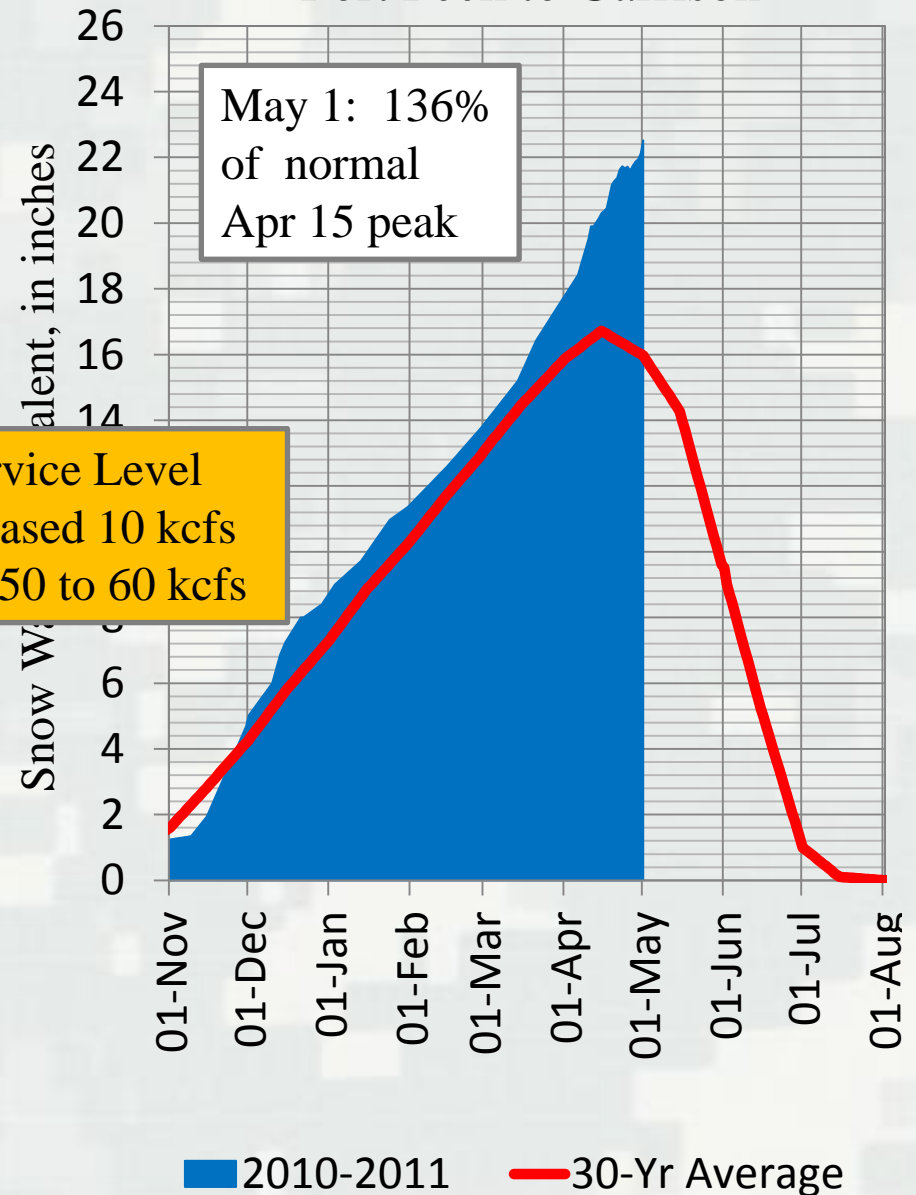


# 2010 – 2011 Mountain Snowpack

## Above Fort Peck

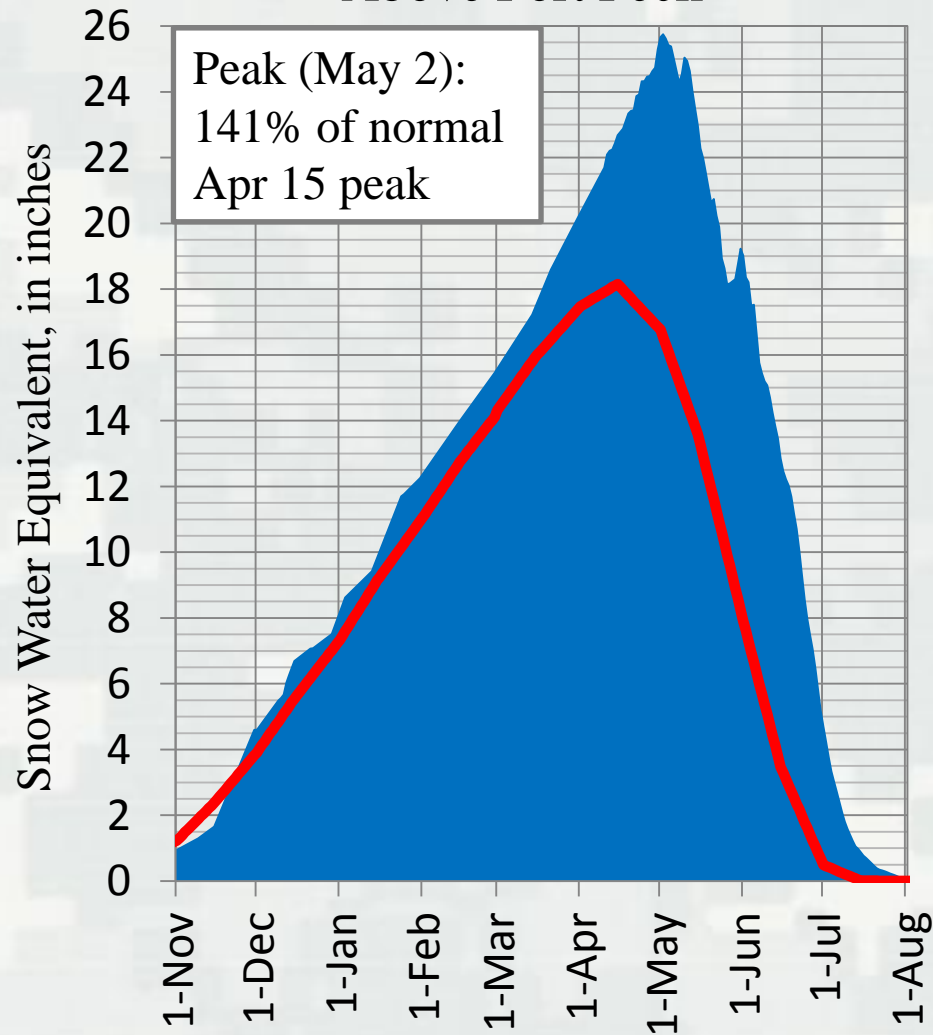


## Fort Peck to Garrison

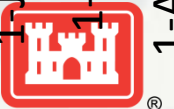
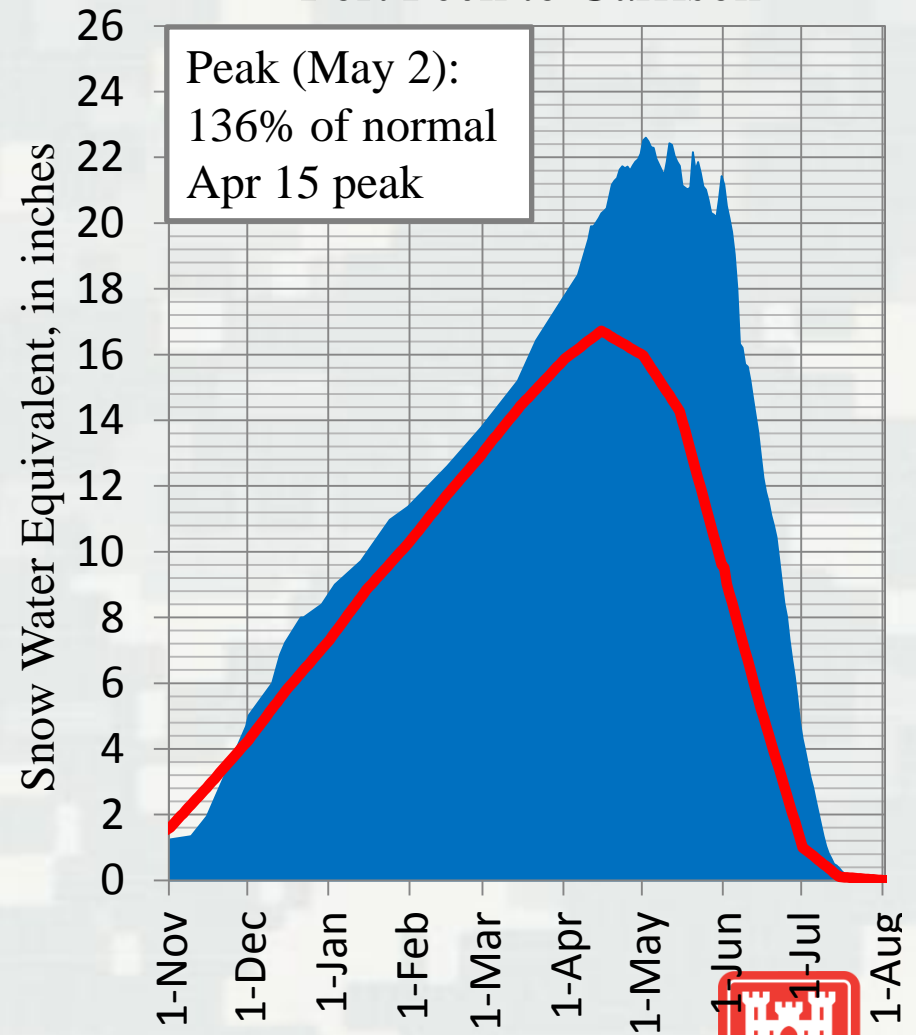


# 2010 – 2011 Mountain Snowpack

## Above Fort Peck



## Fort Peck to Garrison



2010-2011 30-Yr Average

2010-2011 30-Yr Average **BUILDING STRONG®**



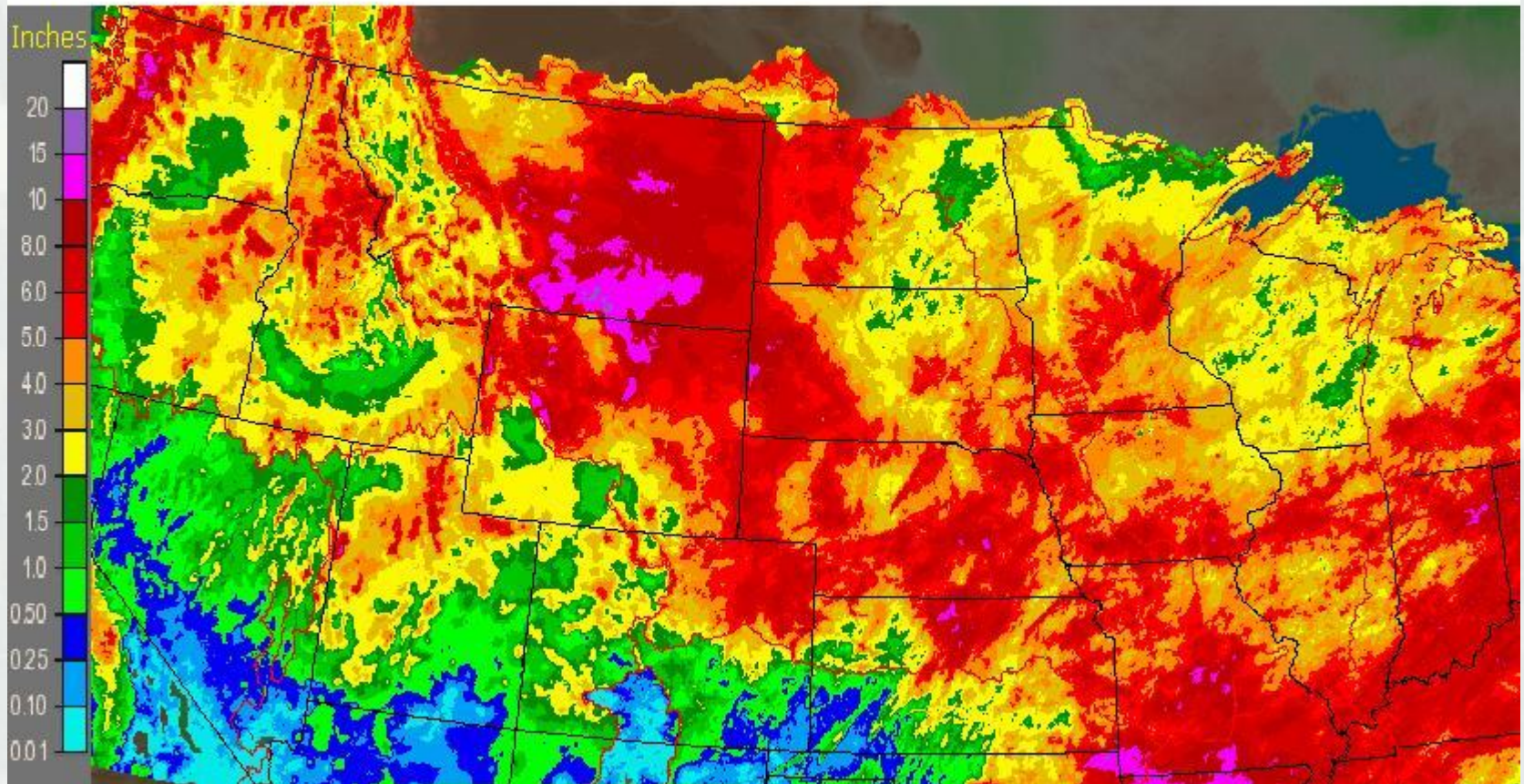
# Bear Tooth Pass – June 12, 2011



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# May 2011 Precipitation (inches)

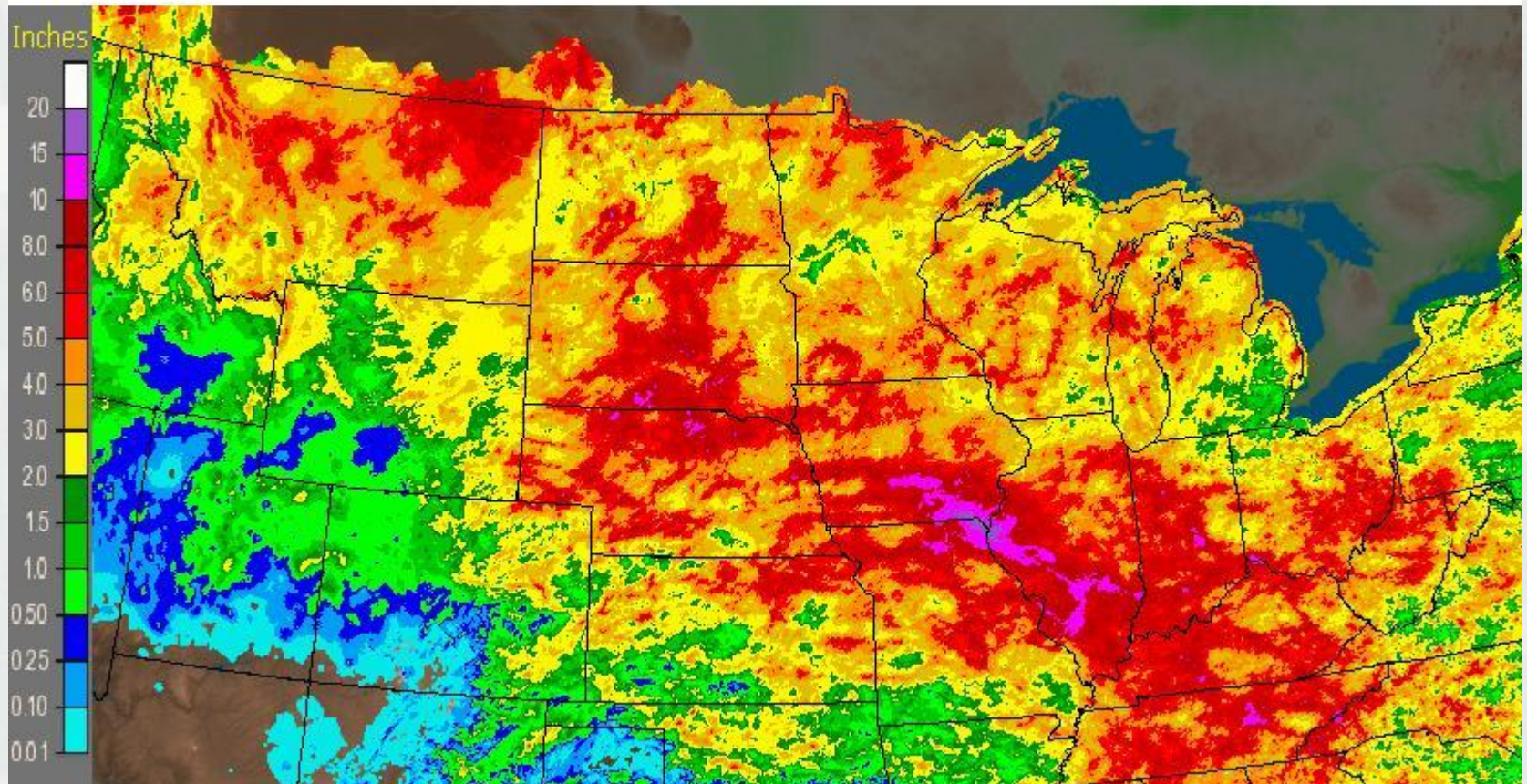
Missouri Basin RFC Pleasant Hill, MO: May, 2011 Monthly Observed Precipitation  
Valid at 6/1/2011 1200 UTC- Created 6/2/11 17:40 UTC





# June 2011 Precipitation (inches)

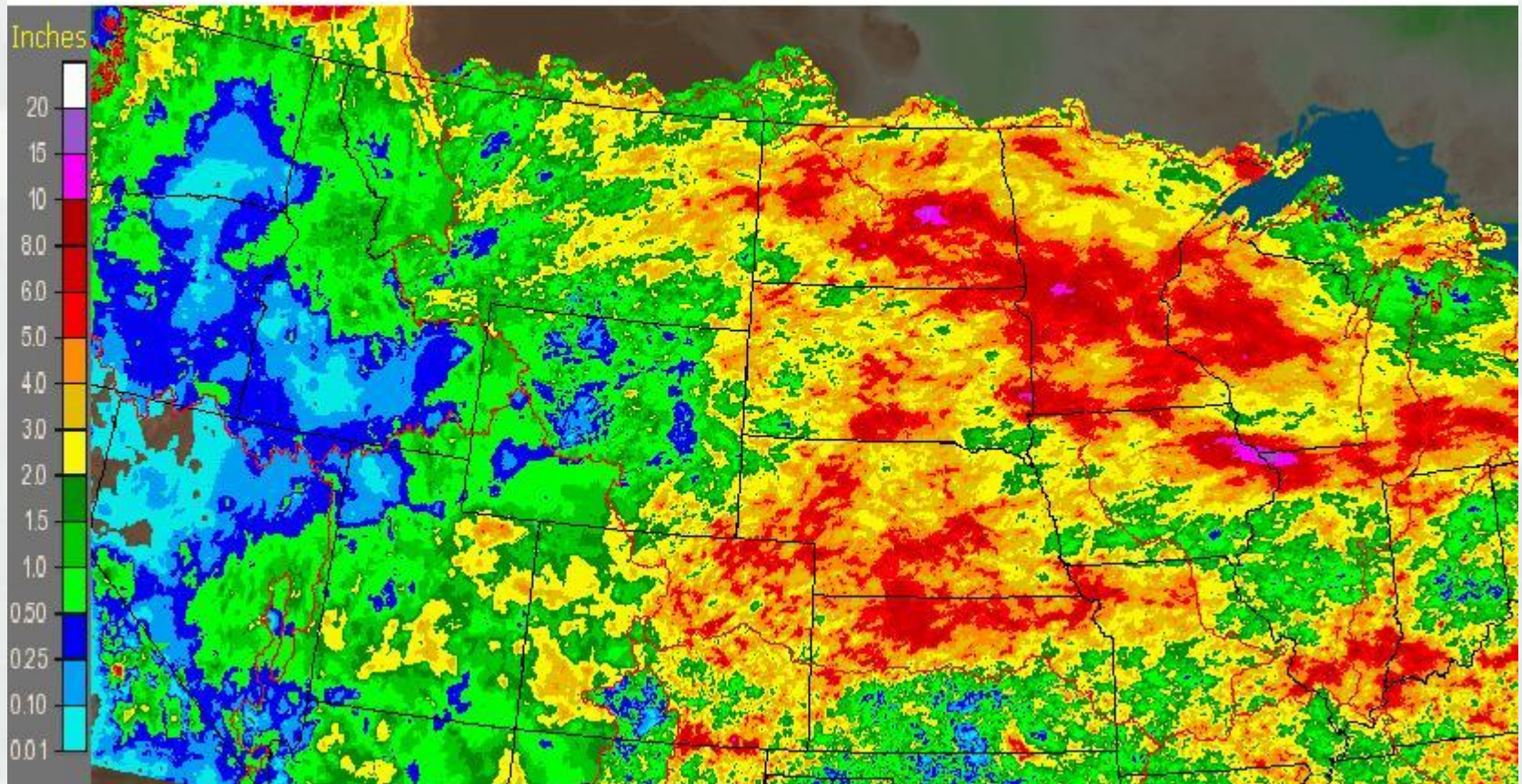
NWS Central Region: June, 2011 Monthly Observed Precipitation  
Valid at 7/1/2011 1200 UTC- Created 7/2/11 17:40 UTC





# July 2011 Precipitation (inches)

Missouri Basin RFC Pleasant Hill, MO: July, 2011 Monthly Observed Precipitation  
Valid at 8/1/2011 1200 UTC- Created 8/2/11 17:40 UTC

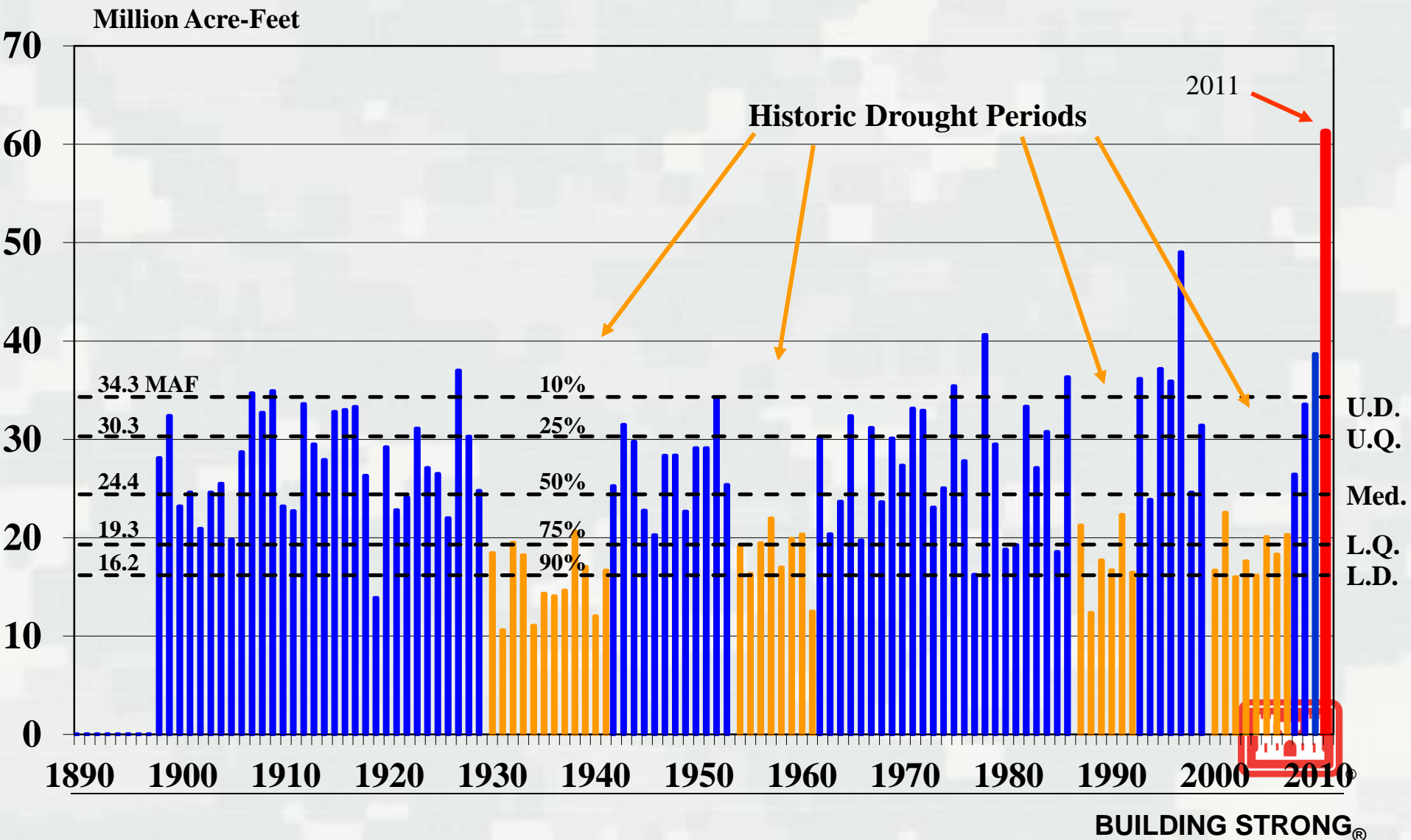


# What Actually Happened

- Runoff in 2011 was 61.0 million acre-feet (MAF), 246 percent of normal and the highest runoff in 114 years
  - ▶ June was the single wettest month on record with 14.8 MAF of runoff, surpassing the old record of 13.2 MAF set in April 1952.
  - ▶ July was the fourth wettest single month on record with 10.2 MAF
- Combined May through July runoff of 34.3 MAF is higher than the total annual runoff in 102 of 113 years in the period of record
- 1881 Design Event Was Exceeded

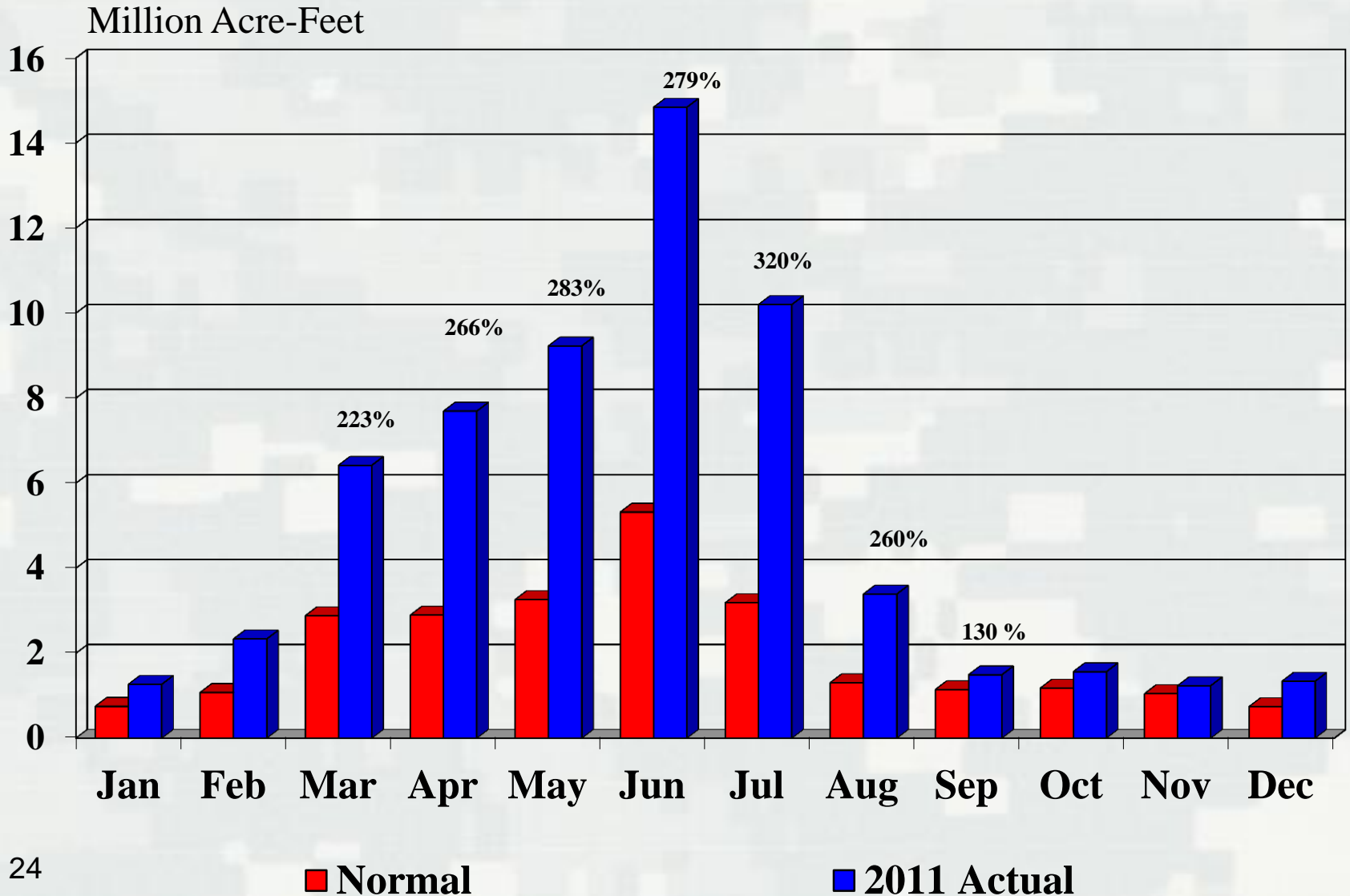


# Missouri River Mainstem System Annual Runoff above Sioux City, IA



# Missouri River Runoff above Sioux City

## 2011 Actual versus Normal





# Fort Peck

Spillway

Construction Started: 1935  
In Operation: 1940

5 Francis turbine  
power units; ~ 15 kcfs  
2 regulating tunnels ~  
45 kcfs

Length of Dam = 21,030 ft; ~ 4 miles

## 2011 Peaks

release – 65,000 cfs  
elevation – 2252.3 (2.3' surcharge)  
storage – 19.0 MAF

## Previous Peaks

release – 35,000 cfs (1975)  
elevation – 2251.6 (1.6' surcharge, 1975)

800 ft  
~ 1 mile  
Spillway capacity\*  
~ 230 kcfs



# Garrison

Construction Started: 1946

In Operation: 1955

3 regulating  
tunnels; ~ 98 kcf

Length of Dam = 11,300 ft

Spillway capacity\*

~ 660 kcf

Never used prior to  
2011

5 Francis turbine  
power units; ~ 41 kcf

## 2011 Peaks

release – 150,000 cfs

elevation – 1854.4 (0.4' surcharge)

storage – 24.0 MAF

## Previous Peaks

release – 65,000 cfs (1975)

elevation – 1854.8 (0.8' surcharge, 1975)

\*Capacity at max operating pool





# Oahe

Construction Started: 1948

In Operation: 1962



Spillway (highly erodible,  
has never been used)

Length of Dam = 9,300 ft

6 regulating  
tunnels; ~ 110 kcfs

7 Francis turbine  
power units; ~ 54 kcfs

## 2011 Peaks

release – 160,000 cfs

elevation – 1619.6 (top of spillway gates – 1620')

storage – 23.0 MAF

## Previous Peaks

release – 59,000 cfs (1997)

elevation – 1618.7 (1995, 1996)



# Big Bend

Construction Started: 1959

In Operation: 1964

2011 Peaks

release – 166,000 cfs

Spillway capacity\* ~

270 kcfs

Never used prior to

2011

Previous Peaks

release – 74,000 cfs (1997)

8 Fixed Blade turbine  
power units; ~ 103 kcfs

Length of Dam = 10,570 ft

\*Capacity at max operating pool



# Fort Randall

## 2011 Peaks

release – 160,000 cfs

elevation – 1374.0 (top of spillway gates – 1375')

Construction Started: 1946

In Operation: 1953

## Previous Peaks

release – 67,000 cfs (1997)

elevation – 1372.2 (1997)

8 Francis turbine  
power units; ~ 44 kcfs

Length of Dam = 10,700 ft

Spillway capacity\*  
~ 508 kcfs

4 regulating  
tunnels; ~ 128 kcfs



# Gavins Point

2011 Peaks

release – 160,000 cfs

Previous Peaks

release – 70,000 cfs (1997)

Construction Started: 1952

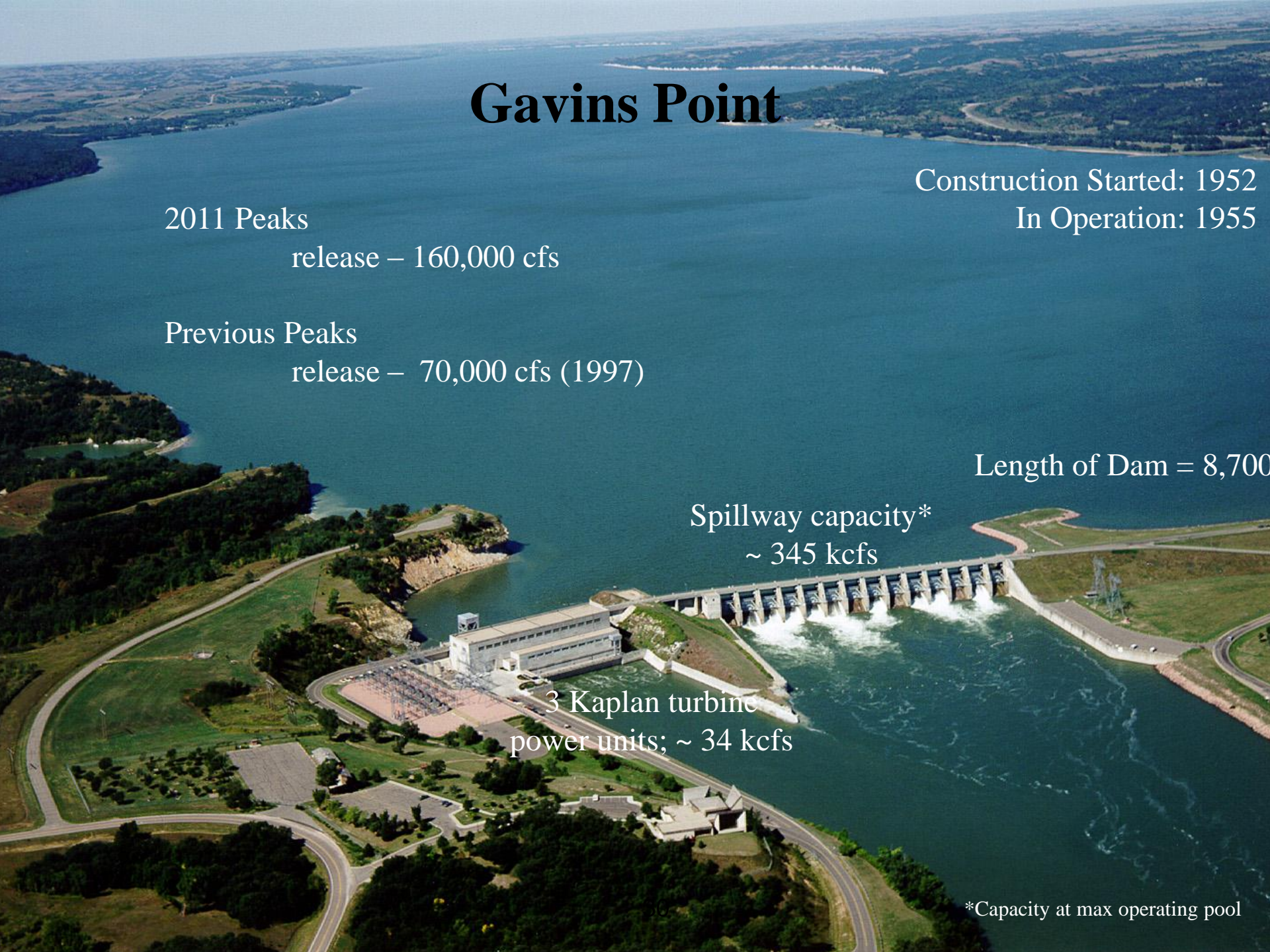
In Operation: 1955

Length of Dam = 8,700

Spillway capacity\*  
~ 345 kcfs

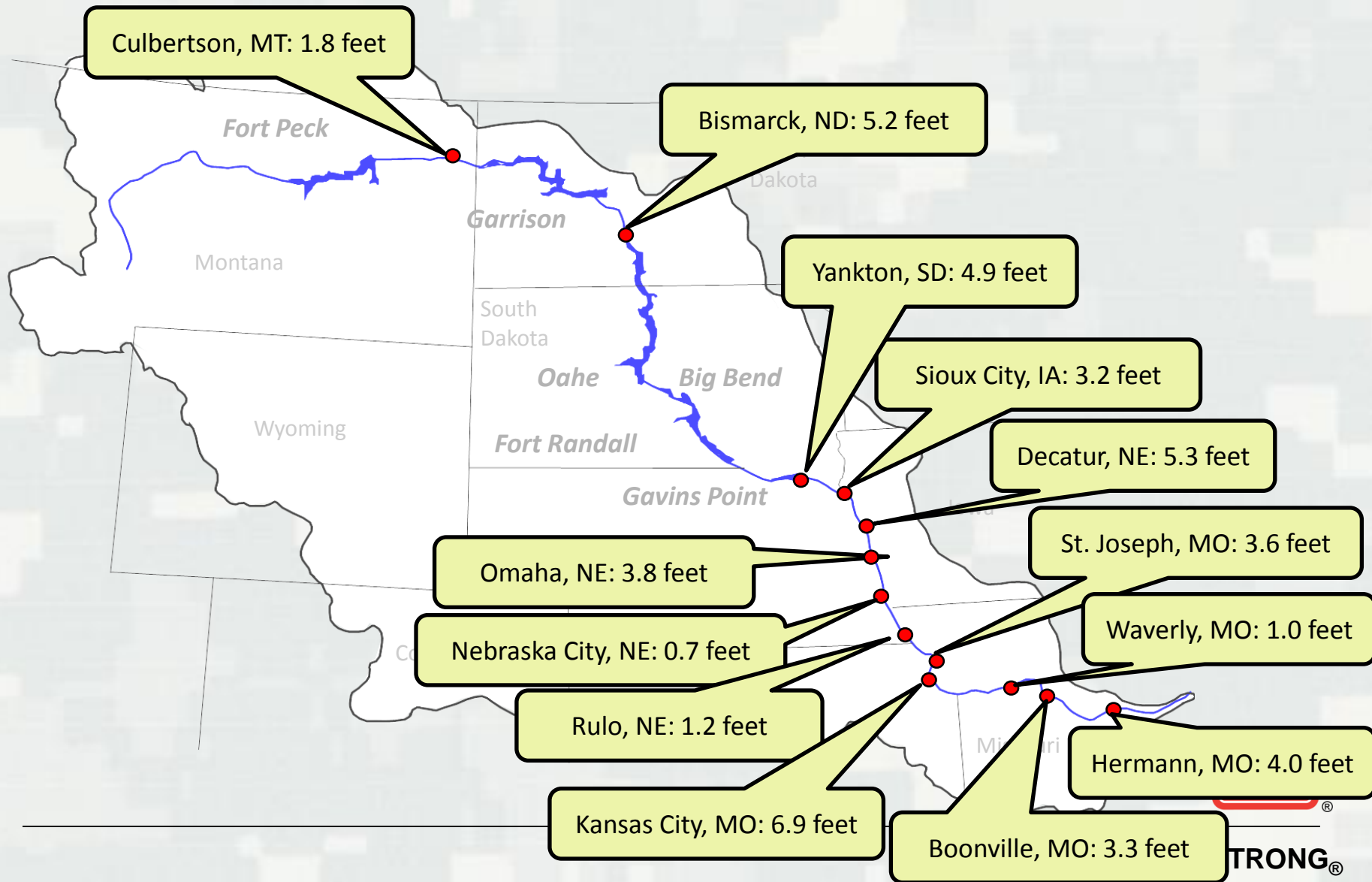
3 Kaplan turbine  
power units; ~ 34 kcfs

\*Capacity at max operating pool





# Missouri River Stage Reduction Due to Reservoir Operations



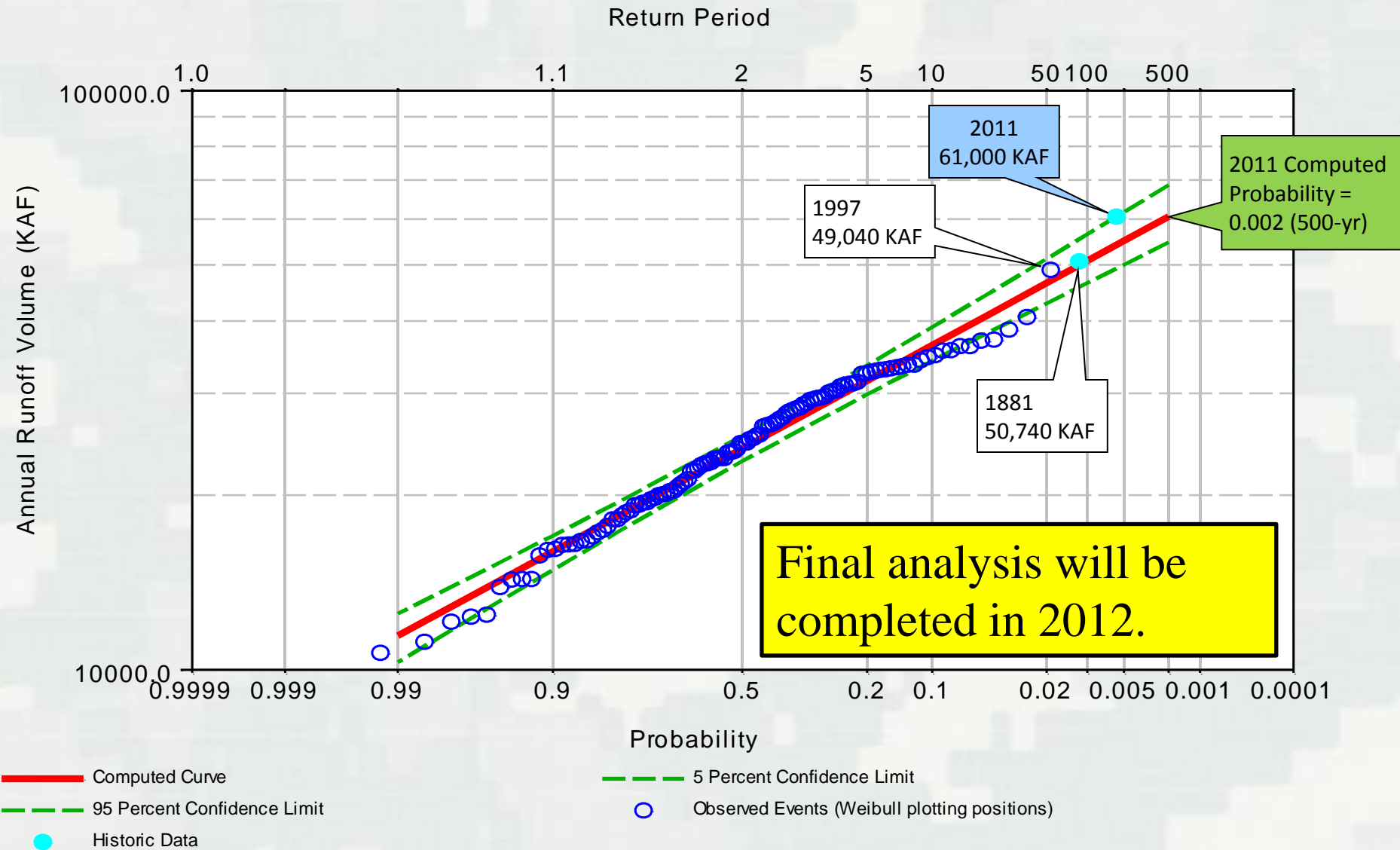
# Flood Damages Prevented

## in \$1000

	<b>Corps Mainstem Reservoir</b>	<b>Corps Controlled Tributary Reservoirs</b>	<b>Levees, Channels, and Other Projects</b>	<b>Emergency Operations</b>	<b>Total</b>
Omaha District	2,207,433	149,585	1,607,749	66,117	4,030,884
Kansas City District	3,238,043	245,246	85,065	28,750	3,597,104
Total	5,445,476	394,831	1,692,814	94,867	7,627,988



# Annual Runoff Volume Frequency





# System Tested as Never Before...

- System storage peaked at a record 72.8 MAF on 1 July
  - ▶ 16 MAF stored flood waters in mainstem reservoirs
  - ▶ Corps and Bureau of Reclamation tributary reservoirs also utilized
- Four mainstem reservoirs utilized exclusive flood control zone
  - ▶ Fort Peck, Garrison, Oahe and Fort Randall
- Three mainstem reservoirs set record pool levels
  - ▶ Fort Peck, Oahe and Fort Randall
- Two mainstem reservoirs utilized surcharge storage
  - ▶ Fort Peck and Garrison
- Spillways at two mainstem dams were operated for the first time
  - ▶ Garrison and Big Bend
- Record releases from all mainstem reservoirs



Thank you.

